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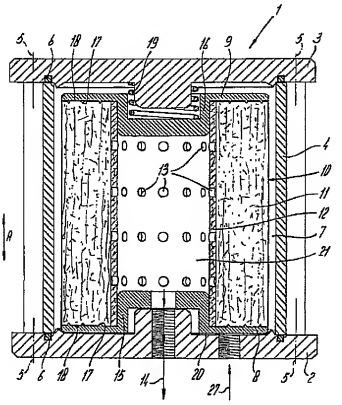
(54) Title: FILTER DEVICE FOR MICROFILTRATION OF OIL



(57) Abstract: The invention relates to a filter device for microfiltration of oil, in particular for use in engines, automatic transmissions and hydraulic applications. The filter device comprises a tubular microfilter cartridge through which medium can flow in the transverse direction and which has open ends. This filter cartridge is accommodated in a filter chamber which is enclosed by a filter housing and is accommodated between two end closure elements, between which the filter cartridge is clamped under prestress. On their surface facing towards the filter cartridge, the end closure elements are provided with at least one rib which extends in the transverse circumferential direction of the filter cartridge. The holding means comprise a spring which acts with prestress on one of the end closure elements, in such a manner that this closure element follows the end wall which it adjoins in the event of longitudinal expansion and also in the event of longitudinal contraction.

WO 01/07142 A1

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Filter device for microfiltration of oil

The present invention relates to a filter device for microfiltration of oil, in particular for use in engines, automatic transmissions and hydraulic systems, the filter device comprising a tubular filter cartridge, through which medium can flow in the transverse direction and which is microporous, with open ends; a filter housing which encloses a filter chamber in which the filter cartridge is accommodated or can be accommodated in such a manner that the filter chamber is divided into a first space which lies outside the filter cartridge and a second space which lies inside the filter cartridge, which spaces are in communication with one another via the tubular wall, which acts as a filter, of the filter cartridge; the filter housing being provided with a first end closure element and a second end closure element for closing off the open ends of the filter cartridge and at least partially or completely overlapping the end walls of the filter cartridge; and the filter housing being provided with holding means for clamping the filter cartridge between the end closure elements under prestress.

A filter device of this nature is known from German Patent DE-3,421,399 C2. The structure which is known from this patent uses a setscrew which prestresses the two end closure elements towards one another and thus clamps the tubular filter cartridge between the end closure elements.

Other designs are also known, for example designs in which the end walls of the filter housing are also the end closure elements for closing off the end walls of the filter cartridge, in which case one end wall is a fixed end wall and the other end wall is a screw cap which, in order for the filter cartridge to be replaced, can be unscrewed from the housing and then screwed back onto the housing. As a result of this screw cap being tightened to a sufficient extent, the filter cartridge is then clamped between the filter-housing end walls, which act as end closure elements.

In practice, however, it has been found that filter devices of this nature still allow some dirt to pass through. The applicant has ascertained that this "leakage" is attributable to slight changes in length which the filter cartridge experiences when the installation in which the filter device is fitted is started up and stopped. Specifically, the applicant has discovered the following:

During operation, the oil which is to be cleaned in the filter is fed to the outside of the filter cartridge at high pressure. Under the influence of the high pressure, the oil will then pass through the filter cartridge and, in the process, contamination will be removed. In filter cartridges of this nature, paper-like

materials, felt-like materials and also glass-fibre materials are generally used as the filter material, in particular for microfilters. In view of the high pressure, these filter cartridges are often supported on the inside of the tube if the external pressure is higher than the internal pressure or on the outside of the tube if the internal pressure is higher than the external pressure. The relatively deformable filter material will then be compressed under the influence of the high pressure and will cause the length of the filter cartridge to increase slightly. When the installation in which the filter device is fitted is then stopped, and the oil pressure is therefore reduced again to a low pressure or to zero, this filter material will expand again in the transverse direction, and the length of the filter cartridge will decrease slightly. As a result, in this state, a small gap is formed between the end wall of the filter cartridge and the respective end closure element. When the installation in which the filter device is fitted is then started up again, and the oil is set in motion once again, with the result that the pressure rises again, there will initially be a moment at which contamination is forced through this gap from one side of the filter to the other side of the filter. Although this phenomenon is only transient, it nevertheless represents a not insignificant shortcoming of the filter device which, in the medium to long term, leads to damage to the installation in which the filter device is fitted.

Now that the cause of this long-standing problem has been detected, the object of the present invention is to provide a filter device of the type mentioned in the introduction in which "leakage" through the gap between the end wall of the filter cartridge and an associated end closure element is prevented or at least reduced. According to the present invention, the problem which has been recognized by the applicant can be solved by two different routes, which two different routes can also be followed in combination with one another, in which case they lead to an even better result than if these two routes are followed separately.

According to the first route, the problem which has been recognized by the applicant is overcome by the fact that at least one, preferably both, of the end closure elements, on its/their surface which faces towards the respective end wall of the filter cartridge, is/are provided with at least one rib which extends in the transverse circumferential direction of the filter cartridge. Under the influence of the holding means, ribs of this nature are pressed into the end wall of the filter cartridge and interrupt the gap which may be formed when the filter device ceases to operate, or at least when the oil pressure is eliminated. It will be clear that this measure stops fine contamination from being forced through the gap when the installation is started up. Since the pressure on the filter cartridge falls when the installation is stopped, the filter cartridge will moreover also tend to expand

slightly in the transverse direction, in which case, if the ribs have already been retracted slightly from the end walls of the filter cartridge, it will still be able to adjoin these ribs under the influence of the reduction in length of the filter cartridge. However, it should be noted that even if, in the event of the rib which has been pressed into the end wall of the filter cartridge coming slightly free from the end wall and of the filter material no longer bearing fully against the rib, the gap which is formed when the oil pressure is eliminated will at any rate wind around the rib at the location of the rib, and this fact alone makes it difficult for dirt to be pressed through the gap.

In order to interrupt the gap along the entire end wall, it is advantageous according to the invention if the at least one rib extends without interruption and in the form of a continuous ring over the said end closure element.

To allow the rib to be pressed into the end wall of the filter cartridge with relative ease, it is advantageous according to the invention if the said at least one rib ends in a pointed edge which is directed towards the respective end wall of the filter cartridge. In this case, it is particularly advantageous if this pointed edge is designed as a sharp edge, as a cutting edge, as it were.

To ensure that the at least one rib continues to extend all the way to the end wall of the filter cartridge at all times, it is advantageous, according to the invention, if the height of the at least one rib, in the longitudinal direction of the filter cartridge, is greater than a predetermined change in length which the filter cartridge will undergo at a predetermined maximum operating pressure of the oil.

According to a second route, which can therefore be regarded as being entirely separate from the first route, but is preferably to be regarded in combination with the first route, the problem which the applicant has recognized is solved by the fact that the holding means comprise a spring which acts with prestress on one of the end closure elements, in such a manner that this closure element follows the end wall which it adjoins in the event of longitudinal expansion and/or longitudinal contraction of the filter cartridge. It is thus possible to ensure that the two closure elements continue to bear in a sealed manner against the end walls at all times, under the action of the prestressed spring.

According to an advantageous embodiment of the invention, the spring is a compression spring which is accommodated, with prestress, between, on the one hand, that side of the said one end closure element which faces away from the filter cartridge and, on the other hand, the wall of the filter housing.

According to an advantageous embodiment of the invention, in this case, the prestress of the spring is at least 3 kg/cm, preferably at least 5 kg/cm, and at most 9 kg/cm, preferably at most 7 kg/cm.

In both solutions (routes) according to the invention, it is advantageous, according to the invention, if the end closure elements are provided, on their side which faces towards the filter cartridge, with a sealing plug which can be fitted tightly into the interior of the filter cartridge. This, on the one hand, ensures that the filter cartridge is securely fixed in the chamber of the filter housing and, on the other hand, provides yet a further seal between the inner wall of the filter cartridge and the sealing plug at the location of the open ends.

According to a further advantageous embodiment of the invention, the filter cartridge comprises a perforated winding core with paper, in particular filter paper, wound onto it.

The invention furthermore relates to a filter housing which is intended for a filter device according to the invention.

In the following text, the present invention will be explained in more detail with reference to an exemplary embodiment which is depicted in the drawing, in which:

Fig. 1 shows a diagrammatic, longitudinal sectional view of a filter device according to the invention; and

Fig. 2 shows a perspective view of an end closure element for a filter device according to the invention.

The filter device 1 according to the invention comprises a filter housing which is formed by a bottom plate 2, a top plate 3 and a cylindrical wall 4 which is situated between these two plates. The bottom plate 2 and top plate 3 are attached to the cylindrical wall 4 by means of screws, which are diagrammatically represented by axes 5. In order to ensure that there is a seal between the bottom plate 2 and cylindrical wall 4 and between top plate 3 and cylindrical wall 4, O-shaped sealing rings 6 are provided.

Inside the housing, there is a first, or bottom end closure element 8, which is fixedly mounted, by means of a drilled-through banjo bolt provided with two sealing rings, on the bottom plate 2, and a second, or top end closure element 9. There is a filter cartridge 10 between the end closure elements 8 and 9. The filter cartridge 10 comprises filter paper 11 which is wound onto a winding core 12 and may comprise a very large number of thin layers of paper. The winding core 12 is provided with perforations 13.

Via feed opening 27, oil is supplied at high pressure and then, as a result of a gap 20 between the underside of the end closure element 8 and plate 2, passes into a first space 7, which lies outside the filter cartridge 10, of the filter chamber. Then, as a result of the high pressure, this oil is pressed in the radial direction from the outside inwards, through the wound layers of filter paper 11, in order to reach the interior of the filter cartridge 10 via the perforations 13, which

interior forms the second space 21, lying inside the filter cartridge, of the filter chamber. From this second space 21, the filtered oil can then be discharged from the filter device via outlet duct 14.

In order to be able to centre the filter cartridge 10 between an end closure elements 8 and 9 and to be able to seal these end closure elements 8 and 9 on the inner wall of the winding core 12, the end closure elements 8 and 9 are provided with sealing plugs 15 and 16 which can be fitted tightly into the interior of the filter cartridge 10.

The two end closure elements 8 and 9 which, apart from the passage opening for the outlet duct 14 in the closure element 8, are of substantially identical design, each have three ribs 17 which project in the direction of the respective end wall of the filter cartridge and extend without interruption, in the form of a continuous ring, over the respective end closure element. As can be seen from Fig. 1, these ribs 17 are designed with a pointed, as it were sharp, edge which is directed into and towards the respective end wall of the filter cartridge. This pointed edge helps the ribs 17 to penetrate into the relatively soft filter material.

If a small radial gap should form between an end closure element 8 and/or 9 and the respective end wall 18 of the filter material 11, the ribs 17, which project essentially in the axial direction, will form an obstacle in the radial gap and will thus make it difficult for contamination to pass through the said radial gap.

Furthermore, the filter housing contains a compression spring 19 which acts between the top plate 3, on the one hand, and the top end closure element 9, on the other hand, and presses the end closure element 9 against the top end wall 18 of the filter material 11 with a prestress of from 5 to 7 kg/cm, with the result that the bottom end wall 18 of this filter material 11 is pressed against the bottom closure element 8. It will be clear that if the filter material 11 then expands or contracts in the axial direction A, the seal provided by the closure elements 8 and 9 will be maintained as a result of the spring 19. If a prestressed spring, such as the compression spring 19, is used, the sealing action of the end closure element 8 and 9 on the end walls 18 of the filter material is improved by the use of the ribs 17, which could also be used separately from a prestressed spring of this nature in order to improve the seal.

The filter cartridge can be replaced by unscrewing the screws or bolts 5 with which the top plate 3 is attached and then removing this top plate 3.

The filter device according to the invention can be used, inter alia, as a so-called side flow filter in an oil-filter device for engines, such as diesel, lpg or petrol engines, automatic transmissions and hydraulic applications.

CLAIMS

1. Filter device for microfiltration of oil, in particular for use in engines, automatic transmissions and hydraulic applications, the filter device comprising:

- a tubular filter cartridge, through which medium can flow in the transverse direction and which is preferably microporous, with open ends;
- a filter housing which encloses a filter chamber in which the filter cartridge is accommodated or can be accommodated in such a manner that the filter chamber is divided into a first space which lies outside the filter cartridge and a second space which lies inside the filter cartridge, which spaces are in communication with one another via the tubular wall, which acts as a filter, of the filter cartridge;

the filter housing being provided with a first end closure element and a second end closure element for closing off the open ends of the filter cartridge and at least partially or completely overlapping the end walls of the filter cartridge; and

the filter housing being provided with holding means for clamping the filter cartridge between the end closure elements under prestress,

characterized in that at least one, preferably both, of the end closure elements, on its/their surface which faces towards the respective end wall of the filter cartridge, is/are provided with at least one rib which extends in the transverse circumferential direction of the filter cartridge.

2. Filter device according to Claim 1, characterized in that the at least one rib extends without interruption and in the form of a continuous ring over the said end closure element.

3. Filter device according to one of the preceding claims, characterized in that the said at least one rib ends in a pointed edge which is directed towards the respective end wall of the filter cartridge.

4. Filter device according to one of the preceding claims, characterized in that the height of the at least one rib, as seen in the longitudinal direction of the filter cartridge, is greater than a predetermined change in length which the filter cartridge will undergo at a predetermined maximum operating pressure of the oil.

5. Filter device for microfiltration of oil, preferably according to one of the preceding claims, the filter device comprising:

- a tubular filter cartridge, through which medium can flow in the transverse direction and which is preferably microporous, with open ends;
- a filter housing which encloses a filter chamber in which the filter cartridge is accommodated or can be accommodated in such a manner that the filter chamber is divided into a first space which lies outside the filter cartridge and a second space which lies inside the filter cartridge, which spaces are

in communication with one another via the tubular wall, which acts as a filter, of the filter cartridge;

the filter housing being provided with a first end closure element and a second end closure element, for closing off the open ends of the filter cartridge and at least partially or completely overlapping the end walls of the filter cartridge; and

the filter housing being provided with holding means for clamping the filter cartridge between the end closure elements under prestress,

characterized in that the holding means comprise a spring which acts with prestress on one of the end closure elements, in such a manner that this closure element follows the end wall which it adjoins in the event of longitudinal expansion and/or longitudinal contraction of the filter cartridge.

6. Filter device according to Claim 5, characterized in that the spring is a compression spring which is accommodated, with compressive prestress, between, on the one hand, that side of the said one end closure element which faces away from the filter cartridge and, on the other hand, the wall of the filter housing.

7. Filter device according to one of Claims 5-6, characterized in that the prestress of the spring amounts to at least 3 kg/cm, preferably at least 5 kg/cm, and at most 9 kg/cm, preferably at most 7 kg/cm.

8. Filter device according to one of the preceding claims, characterized in that the end closure elements are provided, on their side which faces towards the filter cartridge, with a sealing plug which can be fitted tightly into the interior of the filter cartridge.

9. Filter device according to one of the preceding claims, characterized in that the filter cartridge comprises a perforated winding core with paper, in particular filter paper, wound onto it.

10. Filter housing intended for a filter device according to one of the preceding claims.

11. Engine, in particular diesel engine, automatic transmission, or hydraulic application, provided with a filter device according to one of Claims 1-9.

12. Automatic transmission provided with a filter device according to one of Claims 1-9.

13. Hydraulic system provided with a filter device according to one of Claims 1-9.

fig-1

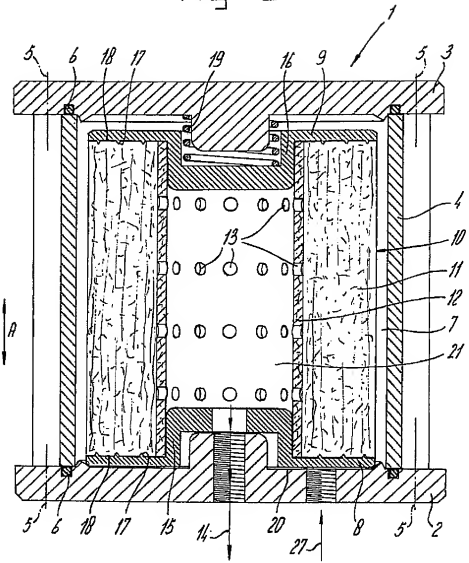
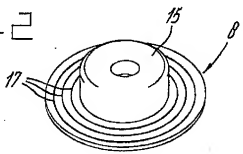


fig-2



INTERNATIONAL SEARCH REPORT

Inter ional Application No
PCT/NL 00/00530

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B01D29/15 B01D27/02 B01D27/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	US 2 525 287 A (CHARLES H. CUNO) 10 October 1950 (1950-10-10) column 3, line 40 - line 64 claims; figures ----	1-4, 10-13
X	EP 0 678 318 A (REUSCHLING WALTER) 25 October 1995 (1995-10-25) abstract column 1, line 19 - line 31 column 9, line 45 - line 55 column 11, line 50 -column 12, line 12 claims; figures	1-4,8-13
A	--- -/--	7

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA	Authorized officer
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 426 064 A (FLEETGUARD INC) 8 May 1991 (1991-05-08) abstract column 5, line 50 -column 6, line 14 claims; figures	5,6, 10-13

INTERNATIONAL SEARCH REPORT

...formation on patent family members

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